Toward Improved Coalition Interoperability –
A Coalition Environmental Approach in the International Strategic Arena

Track
Coalition Interoperability

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Abstract

In the years since the end of the cold war, the Department of Defense, with the military services, has seen a significant increase in taskings for complex-contingency operations (CCOs). The framework for CCO response is found in Presidential Decision Directive – 56 (PDD-56), Managing Complex Contingency Operations, and paralleled in the Federal Response Plan (FRP) of the Federal Emergency Management Agency (FEMA). Traditionally, the response to CCOs has been remedial, i.e., response to the symptoms. However, if root causes could be attacked ahead of time, CCOs might be prevented from occurring. Another facilitating framework for solutions is available.

Recent efforts address many command and control aspects of the Revolution in Military Affairs in the building blocks of technology and doctrine. Another critical block is organization factors. The authors specifically address the extension of a collaborative framework, modeled on the Coastal America Partnership. This framework could be applied on an inter-agency and international basis to support the FEMA's Federal Response Plan implementation, DOD and inter-agency CCO responsiveness, innovative application of technical developments, and allied and coalition interoperability.

The follow-up result could be reduced taskings for CCOs by pro-active collaborative mitigation of societal needs and roots causes, and ultimately improved readiness and coalition interoperability due to sustained resource availability.

Introduction

The Department of Defense, with the military services in the years since the end of the cold war, has seen a significant increase in requirements for complex contingency operations (CCOs). These CCOs have many sources and consume resources originally scheduled for regular operations and maintenance efforts. Climate change is potentially one source of future CCOs, and is potentially the single largest contributor as a root cause of many future challenges that will ultimately result in CCOs. The Executive Director of the United Nations Environment Programme recently warned [U.N., 2001] , "When people are denied access to clean water, soil, and air to meet their basic human needs, we see the rise of poverty, ill-health and a sense of hopelessness. Desperate people can resort to desperate solutions." Along these lines, Owens and Offley [2000, p. 31] have suggested that climate change could escalate into genuine military crises. In fact, the Department of Defense has recognized that there are potential national security implications of climate change and that environmental issues may contribute to economic, political, and social instability and conflict. [ODUSD(ES), 2000, p. 2]

The severity of climate change, and thus the need for those future CCOs, may be within our control today. That is through addressing the other factors that also are the root causes of CCOs, flooding, drought, famine, and disease, which in turn are likely to cause mass migrations, political instabilities, and minor regional conflicts. As mentioned above, these areas are the true root causes for the symptoms that generate the need for CCOs, consume operation and maintenance funding, and reduce resources for increased coalition interoperability and capability improvements for the military services and other agencies that participate in CCOs.

There are great environmental and resource consumption pressures causing population movement, loss of life, and increased expenses to government and non-government organizations treating the symptoms. With respect to humanitarian assistance and disaster relief, it has been suggested that hardening, relocation, education, and stockpiling might be leveraged to avoid many disasters. [Sovereign, 1997, p. 12] But treating the symptoms does not get to the root cause and may not be sufficient to reduce the number and intensity of future complex-contingency operations. A significant factor contributing to the root cause as presented in this paper is environmental pressures with their impacts on the population of the world. Now is the time to address both resource stewardship and quality of life through economic wellbeing and applying the technical environmental solutions at a much larger interagency and international level. It could pay significant synergistic dividends, potentially allowing additional investment in interoperability and preparations for allied and coalition operations.

There is a group which executes joint, interagency, and non-federal partnership projects through collaboration and within existing legislation to address these objectives. The projects focus efforts on restoration, protection, and preservation results, while balancing needs for sustaining BOTH resources availability AND economic well-being for quality of life. The projects represent a less confrontational avenue for the agencies to work together and generate the communication and coordination channels that will support future PDD-56 response actions that are faster, better focused, and better coordinated. The potential for international application of these collaborative solutions to environmental and sustainable resources problems, through the

State Department country teams, would attack the root causes noted above, which generate all types of CCOs – those anticipated by PDD-56 included. Applied on an international basis the efforts also support improved international collaboration and interoperability. If the organizations are already interacting at the lower levels of the work force and organizational groups, then the systems and components that they bring to the table in other actions are more likely to be compatible and improve interoperability. If not already achieved, then the other positive experiences provide a more collaborative foundation for resolution of all types of interoperability problems.

The reduced international demands for assistance would be manifested as lower CCO tasking and, less wear and tear on already rapidly aging of systems, equipment, and personnel. The authors propose an international and interagency collaborative approach to sustaining natural resources with a long-term outcome of reduced military tasking and increased interoperability.

Definitions

Prior to discussion development, examples, and opportunities, several definitions should be reviewed to establish how this paper would use several phrases: *Coalition Interoperability, environment*, *natural resources* and *national resources*.

Coalition Interoperability: Joint Pub 1-02 [12 Apr 02] does not define the combined term *coalition interoperability.* However, the individual terms and an associated *interagency interoperability* are provided. Within DOD, *coalition* is an 'ad hoc arrangement between two or more nations for common action.' For DOD and NATO, *interoperability* is:

1. The ability of systems, units or forces to provide services to and accept services from other systems, units, or forces and to use the services so exchanged to enable them to operate effectively together; for DOD 2. The condition achieved among communications-electronics systems or items of communications-electronics equipment when information or services can be exchanged directly and satisfactorily between them and/or their users. The degree of interoperability should be defined when referring to specific cases.

Thus the two can be combined showing and implying the condition that *coalition interoperability* is the condition when 'ad hoc organizations or groups of organizations work for a common action through exchange of systems, units, or forces; and, the associated services are working together to assist effectively each other for common action.' For this paper it is not only the communications with the electronics systems, BUT ALSO, the people behind the systems, with their capabilities, ideas, and solutions.

Environment: As outlined elsewhere, it is recognized that there is no commonly agreed definition for *environment*, especially in the context of international law. [Boelaert-Suominen, 2000, p. 6] Nevertheless, as used in this paper, environment is not only the scientific set of limiting conditions for testing and evaluating systems, components, organizations, and ideas; but also the natural world climactic and living condition, which is part of everyday life.

Natural Resources: Natural resources are those sources of fundamental wealth – fisheries, farming, mining, harvesting capabilities and quantities – that generate wealth and income – and allow for subsistence and higher levels of survival.

National Resources: National resources are the people and personnel that execute and carry out national policy and foreign policy within the narrow definition of State and Defense Departments' foreign policy. At the same time, in the broadest sense, National Resources are all the interactions that all the individuals as part of the U.S. Government generate in their interactions and dealings.

Returning to Coalition Interoperability, through the personnel side of the proffered definition, the authors point out that another area ripe for benefits besides the international aspects between sovereign entities (as in nations and recognized organizations like NATO, the UN, EU, and OASs), is the truly *ad hoc* disaster response initiative, for both U.S. internal interagency coordination and international coordination. Thus while JP 1-02 provides the DOD definition as posited earlier, for disaster response it can be rephrased to 'Within the context of DOD involvement, the coordination that occurs between elements of DOD and engaged US Government agencies, nongovernmental organizations, private voluntary organizations, and regional and international organizations for the purpose of accomplishing an objective.'

This is the area of PDD-56 - Managing Complex Contingency Operations. As previously mentioned, this area can also benefit from increased coordination and interoperability. In fact, in many ways PDD-56 is not limited solely to internal U.S. application. MGEN Wilhelm, when SOUTHCOM, asked to implement PDD-56 in response to Hurricane Mitch transiting Nicaragua in 1998, to provide a framework for coordinated disaster assistance and relief efforts. This shows the importance of coordination and opens the door to possibilities for solutions and applications beyond those immediately obvious.

Theory of Root Causes

As stated above, complex-contingency operations have many sources or causes. Further, many causes of tomorrow's complex-contingency operations may be within our control today. Therefore, it is beneficial to examine the theory of root causes relative to conflict.

Three hundred years ago, while observing civil conflict in England, Thomas Hobbes studied and identified the root causes of conflict. For Hobbes, there were three distinct root causes of conflict or of the posturing for conflict. Put into today's lexicon, those root causes are (1) *self-interest*, (2) *scarcity of resources*, and (3) *relative equality of strength*. [Hobbes, 1996] In fact, for Hobbes these causes were *necessary conditions*, in that conflict or the posturing for conflict was unlikely to occur unless all three root causes were present. Thus, similar to preventing a fire by eliminating the presence of oxygen or fuel or a source of ignition, conflict can be prevented by eliminating self-interest or scarcity of resources or relative equality of strength. Interestingly enough, the root causes of conflict as identified by Hobbes have withstood the test of time and have found their way into diverse areas of study including war, politics, and even organizational behavior. [Caws, 1989]

Thus the theories of Hobbes present a wonderful opportunity for suppressing or outright eliminating conflict and thus some number of complex-contingency operations. By focusing attention on just one root cause instead of two or all three, conflict becomes less likely.

In today's world, as in the time of Hobbes, the existence of *self-interest* and *relative equality of strength* are universal and endemic. *Self-interest* is self-evident and is a core element of humanity. Relative equality of strength may not appear to be self-evident at first, but then becomes so when one considers asymmetric threats and the nature of modern warfare. [QDR, 2001] Today, of course, a world power can be held at bay by a relatively insignificant power through the leveraging of guerilla warfare, terrorist attacks, public opinion, and the growing disgust over the loss of a single human life. Much attention has already been focused elsewhere on these areas and, therefore, no repetition will be provided here. Rather, focus will be provided on *scarcity of resources*.

Like *self-interest* and *relative equality of strength, scarcity of resources* is also universal and endemic. For Hobbes and his contemporaries, *scarcity of resources* was primarily an issue of acreage, since sustenance and wealth were mostly a function of the amount of land one controlled. Today and in the future, *scarcity of resources* comes and will come in this and many additional forms, including privation related to energy, financial credit, trade, health care, and even the natural environment.

Future Root Causes of Future Complex-Contingency Operations

It is well accepted that maintaining or improving the physical well being of human populations can help reduce instability. That well being generally includes sufficiency of food, potable water, and housing. [Hayes and Sands, 1998, p. 198] Conversely, one can easily conjecture that instability, and thus the probability of engaging in complex-contingency operations, increases as the well being of the population decreases. Therefore, it is informative to examine the forces that can affect the sufficiency of food, potable water, and housing.

Increasing emphasis is being given to the study of the state of the local environments surrounding human populations. Recent studies document the general increase in deforestation with its natural consequences of soil erosion, landslides, and loss of certain natural resources. In addition, there is an ever-increasing loss of groundwater from the unsustainable lowering of water tables and the degradation of aquifers either through the introduction of pesticides and chemicals from industrial operations or from salination due to the intrusion of seawater made possible by lowered water tables. [Brown *et al*, 2001] The loss of groundwater affects humans directly because of the need for clean, life-sustaining, drinking water. The loss of groundwater also affects humans indirectly because of the effect on agriculture and, subsequently, food supplies.

These trends are particularly pervasive in developing countries and are cause for concern due to the potential deleterious effects on our own species. In addition, these trends should be cause for alarm due to the potential for significant increases in complex-contingency operations. [NGS, 1998]

As inferred, the above environmental issues are local in nature. As concerning as they may be, they really pale in comparison to the threats posed by global-climate change. Global-climate change continues to be the subject of debate. Most of that debate has surrounded the validity and accuracy of predictions based on climate-change models. Most recently, the debate has surrounded the current administration's position on the commitment of the United States to the Kyoto Protocol [1997]. Under the Protocol, 39 industrialized nations are committed to reducing substantially the emission of greenhouse gases. The current administration is questioning that commitment not because of the validity of predictions but rather because of the potential impact on the domestic economy and because many developing countries are exempt from complying.

Developing countries are in fact exempt, partly because their contribution to greenhouse-gas emissions is not significant now and not likely to be significant in the foreseeable future. With respect to the economic effects of compliance, the administration's position appears dubious, especially when considering that traditional accountings of GDP do not consider environmental degradation. [Brown, 2001, p. 119] [Gore, 1992, p. 183] [Hodge, 1995, p. 9] Nevertheless, it is not the purpose of this paper to engage in that debate. Rather, it is the purpose of this section of the paper to explore the potential effects of global-climate change on the frequency of complex-contingency operations. Also, it is the purpose of this section to show the opportunity for relief and mitigation investment to reduce the frequency of CCOs, and thus the calls for and impacts of them, thus supporting efforts for improved coalition and interagency cooperation and interoperability.

First, it is instructive to look at the most recent predictions concerning global-climate change. The Intergovernmental Panel on Climate Change (IPCC) was jointly established by the World Meteorological Organization and the United Nations Environment Programme in 1988 to assess the scientific and technical literature on climate change, the potential impacts of changes in climate, and options for adaptation to and mitigation of climate change. Therefore, it provides independent assessments. It is important to note that the U.S. National Research Council agrees with most of those assessments. [NRC, 2001, p. 1]

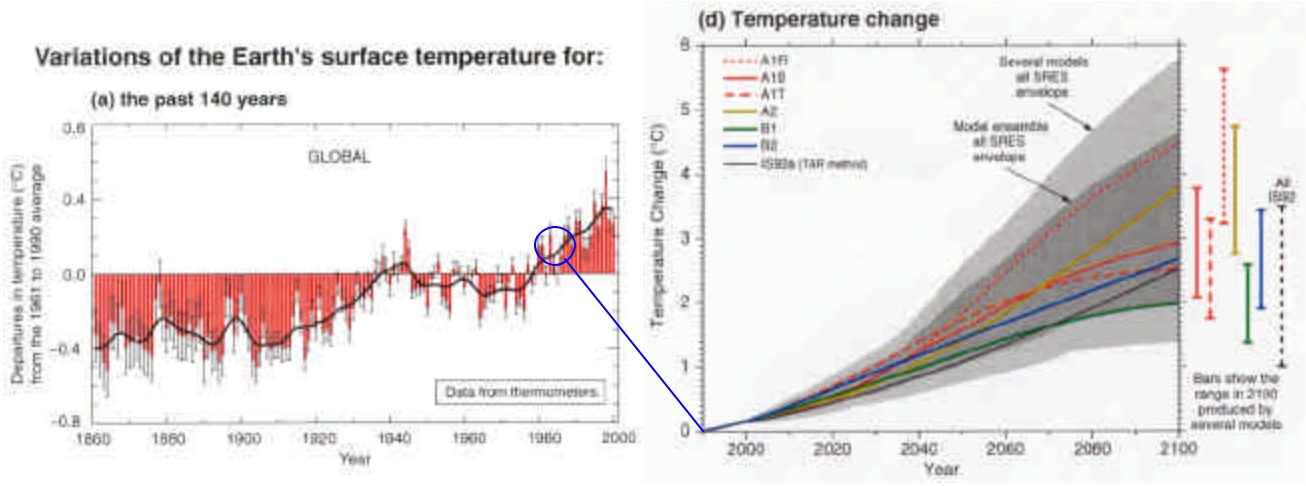

Figure 1 – History of Temperature & Models Projections

Using 1990 as a base year, it projected by models that average surface temperatures will increase by 1.4C to 5.8C by the year 2100. [IPCCa, 2001, p. 13] In addition, globally average sea level is

projected to rise by 0.09 to 0.88m by the year 2100. [p. 16] Associated with changes in temperature and rises in sea level is the variability of climate and changes in the frequency and intensity of extreme climate phenomena such as storms. [p. 15] These predictions should not be difficult to accept. In the 20th century, temperatures rose by 0.6C and the rate of temperature rise increased significantly in the second half of the century. [p. 2] In addition, the sea level rose by 0.10m to 0.20m in the 20th century. So, the predictions of temperature rise and sea-level rise in the 21st century are not inconsistent with what was witnessed in the 20th century. (See Figure 1)

Driving the rise of temperature and sea level is the concentration of global-warming agents in the Earth's atmosphere. The atmospheric concentrations of carbon dioxide, methane, and nitrous oxide increased exponentially over the 20th century (See Figure 2). Also increasing are hydrofluorocarbons and perfluorocarbons, which are powerful global warmers that do not exist naturally. [p. 7]

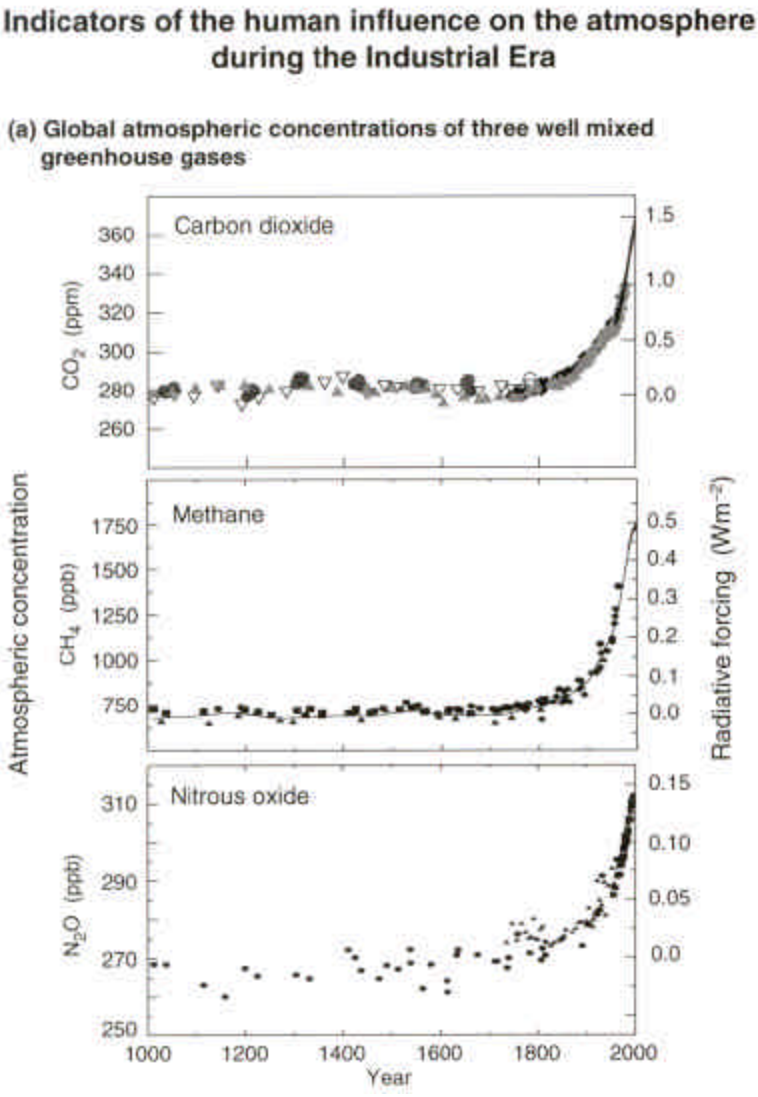

Figure 2 – Indicators in the Atmosphere

Should these recent predictions be correct or nearly correct, what are the consequences? On the positive side, there are some projected benefits to global warming, such as increased crop yields in certain regions, increased global timber supply, and increased water availability in certain regions that are currently water-scarce. Thus, there is high probability that global warming will be welcome in certain areas of the globe. [p. 6] The effect of global warming on human health and disease is less certain and continues to be studied. [IPCCb, 2001, p. 7] [NAS, 2001, p. 4]

However, and of particular interest to the subject of CCOs, severe, negative consequences are also anticipated. Those severe, negative consequences include decreased crop yields in most tropical and sub-tropical regions, decreased water availability for populations in many water-scare regions, particularly in the subtropics, and a widespread increase in the risk of flooding for many human settlements, affecting tens of millions of inhabitants, as discussed in the cited NGS articles. The extent and severity of storm impacts, including storm-surge floods and shore

erosion, are expected to increase as a result of climate change including sea level rise. [IPCCb, 2001, p. 11] Furthermore, these consequences are expected to cause migrations and increase pressures on local governments. [p. 7]

It is easily recognized that the ability of human populations to adapt to and cope with climate change depends on factors such as wealth, technology, education, information, skills, infrastructure, access to resources, and management capabilities. These factors are generally wanting in developing countries, especially among the poorest people of the world. Therefore, this makes the poorest people of the world more vulnerable to the effects of climate change. [p. 8] Thus, by implication, their locations and areas are where CCOs are likely to be implemented.

The number of people potentially involved is staggering. Approximately 1.7 billion people presently live in countries that are water stressed (defined as using more than 20% of their renewable water supply). This number is projected to increase to around 5 billion by 2025 [p. 9] and will certainly place increased stress on governments.

Model-based projections of the mean annual number of people who could be flooded by coastal-storm surges increases several fold (by 75 to 200 million people depending on adaptive responses) for mid-range scenarios of a 0.40m sea level rise by the 2080s. Potential damages to infrastructure in coastal areas from sea-level rise have been projected to be in the tens of billions of dollars for individual countries including Egypt, Poland, and Vietnam [p. 13]. One must remember that the coastal areas, when expanded to include the regions known as the littorals, "provide homes to over three-quarters of the world's population, locations for over 80 per cent of the world's capital cities, and nearly all of the marketplaces for international trade." [OMFTS/CCRP, 2001, p. 342] Thus the coastal regions are not only important, but critical interface areas for not only potential root causes of CCOs, but also, areas for potential solutions.

Models indicate high confidence that coastal settlements along the Gulf of Guinea, Senegal, Gambia, Egypt, and along the East-Southern African coast could be adversely impacted by sea-level rise through inundation and coastal erosion. [IPCCb, 2001, p. 14]

Also, models indicate high confidence that sea-level rise and an increase in the intensity of tropical cyclones could displace tens of millions of people in low-lying coastal areas of temperate and tropical Asia. Furthermore, increased intensity of rainfall would increase flood risks in temperate and tropical Asia. [p. 14]

And for small-island nations, the models indicate high confidence that the projected sea level rise of 5mm per year for the next 100 years would cause enhanced coastal erosion, loss of land and property, dislocation of people, and increased risk from storm surges. [p. 17]

Irrespective of the debates surrounding accuracy of climate-change models and the economic costs of implementing the Kyoto Protocol, the reality is that global-climate change introduces a risk that there will be significantly more demands for CCOs. These demands would be due to the strains placed on the governments of developing nations that are most at risk, border tensions resulting from the migrations of peoples, and the need for humanitarian assistance immediately following the occurrence of natural disasters. In fact, even under the best-case models developed

by the IPCC, the demand for CCOs and the economic costs of providing humanitarian assistance could be overwhelming. Thus, there should be a vested interest in understanding the risks and working now in a collaborative way to mitigate those risks and some of their root causes.

Sovereign [1997, p. 8] has suggested that natural disasters are to be expected, but the ability to predict them relative to location and time with any certainty does not currently exist. The climate-change predictions offered by studies (and partly excerpted above) thus far do not provide that certainty. However, they do offer a valuable insight relative to probable future regional trends. Thus, they also provide areas for addressing future resource allocation and organizational opportunities to potentially mitigate some of the impacts.

Addressing Future Root Causes Today

Having introduced our framework of opportunities for interoperability and the challenges of root causes, the question to answer is 'Why is this important?' The answer to that question is in part the reason for this paper. To explore and introduce another framework which can offer a chance to mitigate 'root causes' of pressures and strife. 'Root causes' which can generate military, agency, and national demands through the generation of CCOs in response to demands for Humanitarian Assistance or Disaster Response (HA/DR).

Coalitions, Agencies and Sovereign countries are all organizations, and they can all be treated and examined under various models and frameworks. The framework of choice is left up to the reader for establishing their model, which helps them gain the most understanding and knowledge.

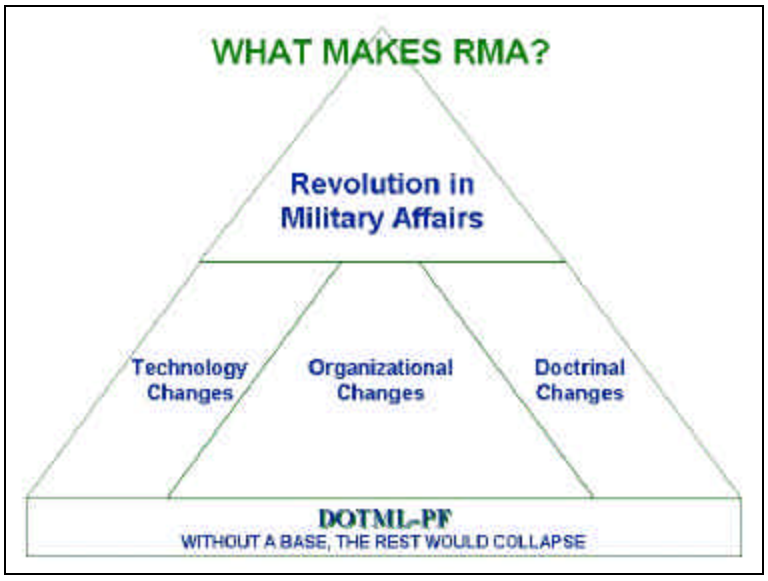

Figure 3 - RMA and Its Foundation

From the authors' standpoint of finding solutions to interoperability, resources, and root causes of CCOs, the organization is only one of the three aspects of the oft cited and discussed Revolution in Military Affairs (RMA), which has received a great deal of beneficial research,

and where advances are being made within the technological area (i.e., C4ISR and the automation aides and procedures) and the Doctrinal area (i.e., through the NMS, JV 2010, JV 2020, and Service and Agency mission, vision, and objectives). These factors are portrayed in Figure 3, and discussed in detail by Fitzsimmons & Van Tol. [1994] Yet, when these are addressed *and* the Organization factors – the people factors or national resource factors – are *not* addressed, the model and structure is not as well established. The triple pieces of technology, organization, and doctrine, are much like the Clausewitzian three-legged stool of Government-Military-Population. When they are not balanced and in alignment, there will be difficulties, struggles, and misunderstanding. Much like those experienced from time to time in everyday life. (N.B. There is the possibility that technology can help to 'mine' the already existing data and assist in the revealing of previously unrecognized (or forgotten) patterns, e.g., Saharan dust into the Atlantic and Caribbean, and thus generate new understanding through the knowledge gained, though the organizational and doctrinal arrangements must be complementary to exploit the 'mined' findings.))

Likewise, if Hobbes' root causes are not addressed satisfactorily, then the spawning action of 'root causes' is likely to be more prevalent, and the demands for agency, service, and sovereign nation response to 'needy voices' will be higher. Demanding more effort and not allowing maintenance and modernization resources ($s) re-investment because those resources are expended trying to remedy symptoms of natural resources availability and allocation problems, a generator of CCOs in a vicious circle . . . 'Where are the relief resources?' . . . 'Where are the resources to improve interoperability? (A variety of the classic guns and butter allocation theory.) It is through addressing the 'root causes' and, through the organizations themselves and their people, that the solutions will be found. It is through fulfillment and collegial cooperation in non-confrontational, long term relationships, which generate success, learning, and understanding, as well as, the applications of ideas and solutions to the problems and root causes that the potential for improving organization interactions (as introduced in the definitions section) may be realized.

Coalition Interoperability: Toward Collegial Collaboration and Environmental Solutions to Root Causes

While some will say that technology can help find solutions, others will say that it is the solution. Technology is not the be-all and end-all. All technology is still developed by individuals. Much as some might project that at some point machines might start creating/recreating themselves . . . the optimistic, liberal approach is that there can be a type of 'coalition style approach' such that the machines and technology assist and support, but do not become the sinister benefactor that takes over and controls everyone.

To visualize this a bit, please see Figure 4. In that figure the reader can see what is on the surface a representation of a very technically challenging engagement and fire control solution. It represents the many technological systems and components that must be produced and manufactured to make a 'smoothly operating' system. A system, that detects, tracks, refines the quality of the track, targets, intercepts, and performs a degree of destruction validation.

Yet, when examined more deeply, it also represents the organizations and personnel that are involved in developing, producing, and fielding the systems. This diagram shows the systems capabilities regarding fusion of data and technical capabilities to provide better targeting capability, it also addresses the ability of the organizations that produce those capabilities to work together. When the systems must interface and hand off information, the organizations must also 'come together' to find and generate the solutions that will allow that successful transfer of information. In short, if the organizations are talking and working together, then the technological solutions, the resource dollars, and the opportunities are available and more likely to produce the needed results and solutions with a lot less friction and resistance. In short it will be easier to find solutions, which is in alignment with the cited benefits of network-centric warfare. [Alberts *et al*, 2000]

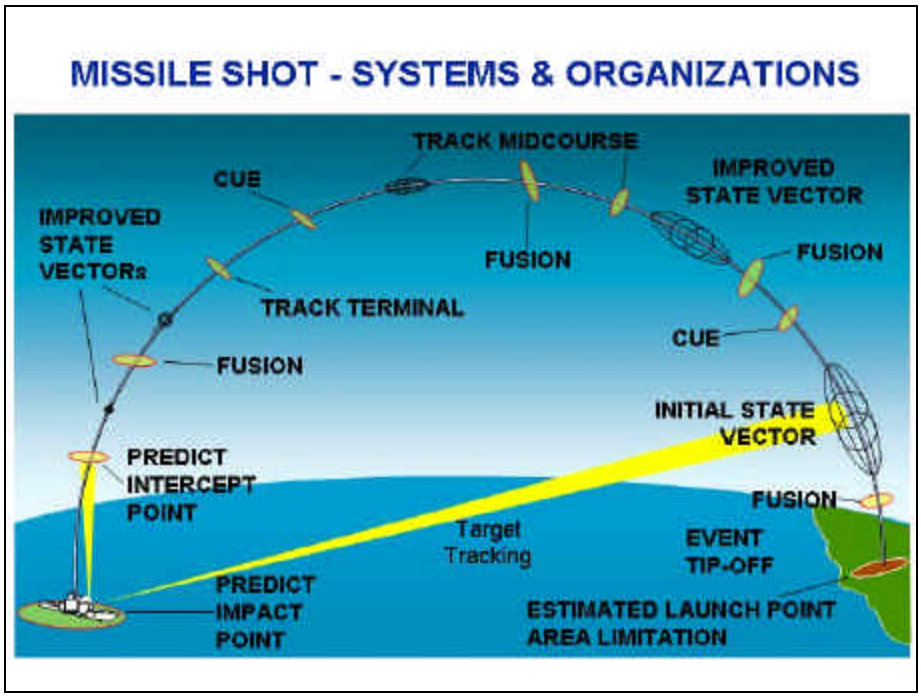

Figure 4 - Missile Shot - Systems & Organizations

A specific military point about interoperability is worth recounting. Several years ago, the John F. Kennedy Battle Group was going through its work up and preparations for deployment, while also testing its new Advanced Combat Direction System and Cooperative Engagement Capability software and hardware. Unfortunately, when three of the vessels tried to communicate – they did not and could not transfer information and communicate in an interoperable arrangement! [Smith et al, 2000] [Smith et al, 1999]

The resulting action was to establish a focused coordination team to find the solutions and implement them, thus heading off this level of difficulty in the future. The team's success has been proven, and many significant improvements and successes have taken place since the initial problem. However, it also points out what can happen when two pieces of the same organization have some improved coordination opportunities and do not make the best use of them. The initial encounter was painful, yet it was also worthwhile in generating the impetus for and

resulting in the ultimate capabilities improvements. It not only took organizational leadership, but individual effort and organizational adaptation, coordination and growth, all accomplished via the individuals who were involved. Not only must the systems, the sections of organizations, and the individuals wisely expend the resources available, but they must be expended like the Judo maxim: 'minimum expenditure of effort for maximum return'.

Another example of collaborative efforts and experiences is available within the Coastal America Partnership. It is composed of a government partnership of 12 Agencies, along with state, local, tribal, volunteer and business groups, all joined together in voluntary actions and common effort to support and restore natural resources. The Coastal America Partnership (CAP) Memorandum of Understanding states as its purpose to:

(1) protect, preserve, and restore the Nation's coastal ecosystems through existing Federal capabilities and authorities;
(2) collaborate and cooperate in the stewardship of coastal living resources by working together and in partnership with other Federal programs, and by integrating Federal Actions with state, local, tribal government, and non-governmental efforts; and
(3) provide a framework for action that effectively focuses expertise and resources on jointly identified problems to produce demonstrable environmental and programmatic results that may serve as models for effective management of coastal living resources. [CAP MOU, 1992]

These statements are both simple and at the same time very prophetic toward offering hope for solutions and addressing aspects of the root causes outlined previously. Through restoring and sustaining natural resources and the ecosystems that support them, there is the potential for reducing, maybe even removing some of the pressures and competition for those resources. Competition and desire that the authors argue are in some ways the 'root causes' of conditions that generate (or degenerate into) CCOs and increased tempo of operations for our military forces, allies, and other responding groups. Quite literally, both approaches mentioned are NOT BUSINESS AS USUAL.

Examples of Collaboration and Potential Benefits

This paper's introductory and discussion sections thus far have established the ground work and several foundation blocks. The authors will now span these through the discussion of several projects and the projected possible synergistic interaction through technology innovation and use; group inter- & intra- communications; and, bolstering organizations confidence for success and learning for future growth and improvements. The examples are from several different CAP projects which highlight agency / source sponsors and offer multiple levels of opportunities for future growth, improvement, and return on investment. The areas being linked / bridged are: aspects of pollution abatement / mitigation; habitat characterization and restoration; local and remote sensing of habitat /environment; and, habitat and natural resources management. This is then followed with a summary section regarding implications.

The first example is associated with non-point source pollution (NPS) from milkhouse waste discharge project [Milkhouse, 1994], which was started in 1992. At that time, because of the

lack of viable treatment/disposal designs for milkhouse waste, farmers were finding disposal a challenge – both environmentally and economically. The treatment of milkhouse wastewater by constructed wetlands was one of several demonstration projects that were part of a comprehensive Milkhouse Waste Management Program being conducted under the Wisconsin Water Quality Demonstration Project – East River, to assist farmers in identifying effective treatment alternatives. The wetland treatment has since

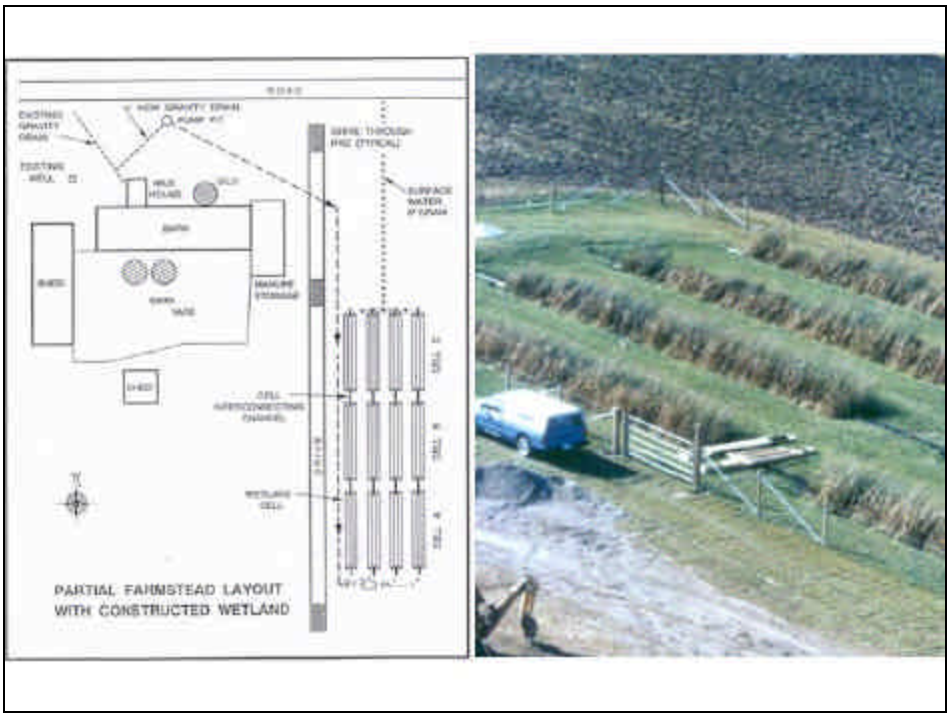

Figure 5 - Milkhouse Waste Discharge Project

been evaluated as an innovative, low-cost alternative to the transfer of milkhouse wastes to manure storage units. For the project a constructed wetland, designed to optimize natural, physical, chemical, and biological processes, was established on a farm in Greenfield, Wisconsin, during the summer of 1992. Its operation has demonstrated this option for treating non-point source (NPS) pollution associated with the dairy industry. This was accomplished through a team effort of federal and state groups. The team was led by the Environmental Protection Agency (EPA), and had five other members. [Milkhouse, 1994]

This project, while applied to dairy farms, has potential applicability to other segments of the animal husbandry industry (poultry and swine), for treating /mitigating pollution run off and its degree of impact on the resources of the environment. Its mechanism is also used with gray water irrigation re-use projects and available for treatment of other run-off water. It can potentially address the satisfaction levels of populations through improving the quality of their water supply, and thus their health.

Monitoring the health of the wetlands is a measure of its performance which can be accomplished directly and indirectly. The health of this vegetation is integral to its function to

uptake excess nutrients/pollutants, and thus monitoring is important. The rate of vegetation growth can provide a measure of effectiveness.

The diverse team involved demonstrates cross-agency / organization groups working out solutions for the complete group and drawing on their individual strengths to help all involved accomplish this project.

The next three projects are illustrative of monitoring and characterizing the vegetation with monitoring / survey systems, and alternative / collaborative efforts for vegetation restoration / invasive species removal projects and different methods of remote monitoring and sensing.

The second project is a joint eelgrass study which was done in 1997. [Eel] This study brought together a previously disassociated group of efforts. The Navy was independently working on the detection of submerged vegetation due to its military implications in undersea warfare. Additionally, the Army Corps of Engineers was mapping seagrass because of its habitat value and significance for dredging projects, while the United States Fish and Wildlife Service (USFWS) and EPA's National Estuary Program were interested in seagrasses for habitat management purposes. The coordination of these independent efforts afforded an ongoing dialogue that produced habitat mapping used for resource management, and provided new tools for technological advancement in the military and civilian communities through initiating research for the benefit of all the agencies.

In August, 1997, the team carried out its investigation into the acoustic properties of eelgrass in Narragansett Bay, RI. The Corps integrated 410-kHz sonar with differential Global Positioning System (GPS) for accurate positioning and recorded the acoustic backscatter from eelgrass beds which was combined with a Navy dive team that performed ground truth referencing by carrying out systematic sampling which included filming more than 50 minutes of underwater video. Additionally, a 100-kHz side-scan sonar was employed for some detailed and boundary characterization data.

The study results were presented at the International Conference for Remote Sensing for Marine and Coastal Environments. More importantly, it established a new avenue of communication between state and federal agencies. With that new communication channel between the military and natural resource agencies in Narragansett Bay, the partnering process enhanced their individual project benefits and produced results beyond those of the direct action. The project quite literally advanced the several teams further than they might have gone individually.

This demonstrates the potential for interagency collaboration, and the possibility for non-traditional approaches to compound results between organizations for the benefit of all.

The third project to be discussed is the Naval Postgraduate School dune restoration effort. This project partnered three federal groups with the local city government and several volunteer groups. [Dune, 1994]

This project was to reestablish an ecological dune plant community with indigenous plants, and remove the invasive species. Its opportunity was generated by a severe winter freeze

(1990-91) that killed much of the non-native ice plant in the dunes. (The remainder was iradicated, with other weeds managed via an aggressive control program.) Over 150,000 seedlings have been planted, representing 26 species of native dune vegetation and all exotic vegetation was removed using volunteers from the Monterey Dune Coalition and the Big Sur Land Trust. Only native plants were used to enhance the habitat for the endangered species known to frequent the area, specifically, Smith's Blue butterfly, the black legless lizard, as well as the dune gilia (Gilia tenuiflora ssp. Arenaria, an annual herb of foredunes and coastal scrub communities). Additionally, the use of native plant material would minimize the reoccurrence of vegetative loss on the dunes should another freeze occur. The project received endorsement from the California Coastal Commission, the USFWS, the Monterey Dune Coalition, the Big Sur Land Trust, and the California Native Plant Society It was recognized for its use of native plant materials in the restoration of a coastal dune bluff ecosystem, plants that much more freeze tolerant, and thus able to limit or mitigate possible dune loss from potential future freeze induced plant loss.

This project shows the wisdom of removing invasive species, supporting the native species (natural resources) for the ecosystem, and the teamwork involved in executing the project as a group with a mixture of individuals. It married resources: Navy funds, USFWS plants and expertise, with city and volunteer group labor, to align strengths with needs to execute this collaborative project. Like the milkwaste project, it generates a community of plants which can be locally and remotely monitored for their health and viability. Team monitoring and analytical methods that were alluded to and mentioned previously in the eelgrass project discussion previously demonstrate how other methods can be employed for monitoring the project status and opens the door to the last project – Naval EarthMap Observer – NEMO. (Depicted in Figure 6.)

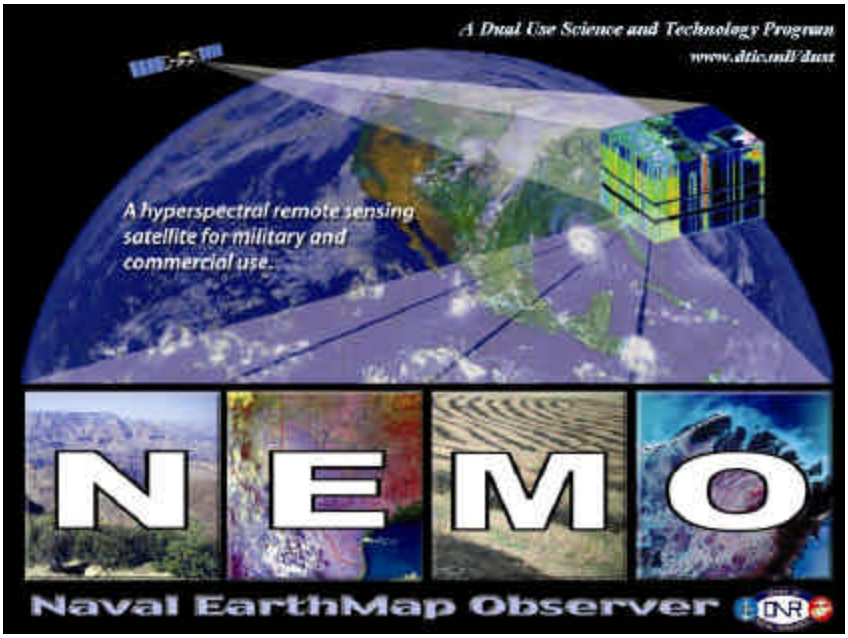

Figure 6 - Naval EarthMap Observer

The Naval EarthMap Observer [NEMO] is a hyperspectral remote sensing technology initiative was started in 1997 via a Navy and industry team (under the direction of ONR's Naval Space Science and Technology Program Office) to produce the first commercial hyperspectral remote sensing satellite for Naval use to be launched early this century. The NEMO satellite is to be capable of meeting the hyperspectral and panchromatic needs of many end users with improved timeliness and spatial resolution over existing commercial systems. The Navy's environmental models and knowledge supporting operations in the littoral battlespace environment will be considerably enhanced by the hyperspectral imagery and data products via the remote sensing of bathymetry, water clarity, and trafficability information.

Additionally, the imagery will also satisfy a number of requirements of the commercial and scientific communities for moderate spatial and high spectral resolution remote sensing data over land and water such as agriculture, forestry, environmental monitoring, geology/mineralogy, hydrology and land use. Other specific areas of interest for the Navy include currents, oil slicks, bottom type, atmospheric visibility, tides, bioluminescence, beach characterization, underwater hazards, total column atmospheric water vapor, and detection and mapping of subvisible cirrus cloud formations. All these are characteristics that can be useful in other federal agency monitoring and predictive services missions ranging from plant, water, and animal resource management, to disaster response and mitigation efforts (i.e., beach erosion, water run off pollution, algae bloom, or flooding).

It is anticipated that satellite/spacecraft downlink capability for real-time employment of the hyperspectral data will be demonstrated to U.S. Naval users. Customers within the Navy are: Naval Oceanographic Office; Warfighting Support Center; Naval Air Warfare Center; Naval Undersea Warfare Center; Naval Surface Warfare Center; and SPAWAR Systems Center. And other users may be expected in the future, ultimately potentially all services and agencies.

For example, there is the possibility the EPA's Clean Water Act (CWA) monitoring task could be supplemented through the use of the NEMO hyperspectral data in support of the Index of Water Quality Indicators. Taken together, the NEMO data along with the other monitoring systems, and already existing data bases, are remarkable resources for data mining. [NEMO a] Thus, monitoring the health of the natural resources can be improved, which can assist in supporting and stabilizing populations. The collaborative efforts between groups at the interagency federal, regional, organizational and non-government levels provides a chance for synergy to produce results beyond those of the direct investment.

Thus via the examples cites, communication channels are opened, new ideas are introduced and exchanged, and there is the potential for exchange of lessons learned with growth through sharing of experiences and knowledge. While the exchange and communication may generate some 'it was not invented here' reaction, there is more likelihood, based on the experiences of CAP and other efforts, that collaborative partnering can be significantly successful for leveraging limited resources for large returns on investment.

That is the significance of this set of examples. While not directly related, they represent what non-traditional partners can accomplish through collaboration and leveraging of individual organization's strengths and resources. The increased communications and the feedback from

successful efforts can open other doors for increased collaboration and partnering. When viewed in an international perspective, many of the agencies working together also have international responsibilities either directly or indirectly through our Embassies, Consulates, and their varying levels of participation with non-governmental organizations / inter-governmental organizations (NGOs/IGOs). They are all impacted (directly or indirectly) by the direct causal linkage of natural resource abundance (or scarcity) with the populations that use, need, or desire them. This is especially true when the populations are forced into migration by natural events, non-deliberate acts, or deliberate acts that displace segments of populations. [NGS, October 1998] As mentioned previously, a root cause of population displacements (which generate immigration or refugees) is the challenge of maintaining sufficient resources and access to them, to address the various components which lead to societal satisfaction, comfort, and assurance. [Hayes & Sands, 1998]

The chain is: With natural resources sustained and maintained, the population pressures are reduced, reducing strife, conflict, and birth rates. The reduction in level of strife reduces the number of calls and need for military response and assistance via CCOs, thus reducing the consumption of operations and maintenance funds and the accelerated aging of the systems. This reduction of consumption and accelerated aging, if judiciously coupled with the increased organizational collaboration at many levels (personal, personnel, and technical) (as shown through the examples) can result in more investment in modernization and technical solutions for the interoperability of collaborating groups (national and international), and thus support understanding and interoperability in the future.

To state this another way, many of the recent military employments have been related to humanitarian assistance and disaster relief efforts. Many of those are responding to the types of population pressures noted above. The tools of data collection and data base analysis and mining, along with the collaborative efforts addressing natural resource restoration, protection, and preservation are the foundational building block for application to other areas – CCOs – so that military employments are reduced, and the strain on military resources and materiel are reduced, thus allowing more collaboration and improvements for interoperability for the future.

These examples cited point out interagency non-confrontational efforts, along with technological and organizational solutions – groups working together, bringing their expertise to the task for a common result and leveraging their skills and resources for larger returns on investment.

Like the CAP model, this implied international model points out innovative opportunities and solutions. The models both represent opening communication channels and establishing networks between organizations and individuals which can assist and support all involved – for discovery and application. That is the point of communication and understanding which underlies the implementation of PDD-56 and the Federal Emergency Management Agency Federal Response Plan. That because the individuals and organizations are already working together on other projects and in other areas, when a potential crisis arises, the solutions are more likely to flow faster and smoother – due to previous established understanding and experience.

This is the foundation for using the CAP model of interactions to build increased collaborative solutions and improved interagency coordination. By extension, this model could also be used internationally, because all the partner federal agencies also have agency representatives on the Embassy staffs, and thus they could be focal points for similar natural resource solutions and collaboration on an international basis addressing some CCO's root causes – that lack of natural resources cause population migrations and population pressures.

In addition, there is a need for a collaborative development of strategies for dealing with climate-driven, complex-contingency operations. Even under the best scenarios, where the international community reduces the emission of global-warming gases, the climatic effects on certain human populations is quite severe and unlike anything we've experienced in living memory. Therefore, preparation is necessary. The collaborative partnering outlined in this paper can be a starting point for organizations to share skills and technologies for solutions prior to *in extremis* crises.

Summary & Recommendations

As previously stated, it is well recognized that CCOs consume valuable financial, materiel, and personnel resources that could be better applied to support Department of Defense missions if only such operations could be avoided in the first place. Given that CCOs have root causes, it might be possible and even profitable to attack those root causes today as a means of avoiding those operations that are otherwise likely to occur in the future.

One such root cause is climate change, which threatens to contribute to major economic, political, and social instabilities in very significant ways over the next 50 to 100 years. It is not difficult for one to imagine the potential for numerous regional conflicts caused by such instabilities, or even a substantially increased need for humanitarian assistance and aid. Thus, it would be most wise to move beyond a mere recognition of climate change as impacting national security and consider in depth the likelihood and magnitude of the potential consequences of climate change.

A means of attacking climate change as a root cause of future CCOs is coalition interoperability. Synergistic, cooperative partnerships between DOD, its allies, state and federal agencies, and non-governmental organizations around the world could have a dramatic effect on the creation of intelligent policies as well as the development and exchange of technologies that could sharply impact the predicted trends of climate change. Such coalition interoperability could leverage limited research and development resources and magnify the benefits at multiple levels at the same time in a significant way as seen in the examples cited.

DOD (and State Department) have a vested interest in understanding the consequences of climate change and assuming a leadership position in assembling a coalition designed to find and implement solutions. In fact, it's quite possible that the DOD, with State Department, cannot afford to take any other course of action.

The authors recommendations are:

- Study the probable impact of climate change on the number and intensity of future complex-contingency operations. Including how these complex-contingency operations are likely to tax future limited resources, and develop a course of action to potentially address those impacts.
- Study and test the mechanisms by which coalition interoperability can be leveraged effectively to address climate change, thus moving ahead toward solutions.
- Make collaboration, al la the CAP model, a part of the measureable performance standard of all agencies within their policy and strategic plans to be evaluated and reported under the Government Performance Results Act (GPRA).
- Establish a State Department (Global Affairs) policy to carry the CAP framework for collaboration environmental action to the international arena as a tool of nation power.

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[NEMO] http://www.onr.navy.mil/sci%5Ftech/ocean/projects/nemo/prog_org.htm ; [1] NEMO will demonstrate the utility of a multi-wavelength Earth-imaging system to support Naval needs for characterization of the littoral regions of the world (i.e., water and coastline areas within 50 km from shore). The system will provide images of littoral regions with 200 spectral bands over a bandpass of 0.4 to 2.5 µm. Since ocean environments have reflectances typically less than 5%, this system will require a very high signal-to-noise ratio. The Hyperspectral Imager (HSI) would sample over a 30 km swath width with a 60 m ground sample distance (GSD) with the option to go to 30 m GSD by utilizing the systems attitude control system to 'nod' (i.e. use a satellite pitch maneuver to slow down the ground track of the field of view). A 5m panchromatic imager will provide simultaneous high spatial resolution imagery. A sun-synchronous circular orbit of 600 km will allow continuous repeat coverage of the whole earth. A unique aspect of this system is the use of a feature extraction and data compression software package developed by the Naval Research laboratory (NRL) called the Optical Real-Time Spectral Identification System (ORASIS). ORASIS employs a parallel, adaptive hyperspectral method for real time scene characterization, data reduction, background suppression and target recognition. The use of ORASIS is essential for management of the massive amounts of data expected from an orbiting HSI system.

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